Fig.1: *C. hemiodon* ventral side

region of Kanyakumari region (Tamil Nadu, India). When the fish was dissected for research purpose we found four young ones inside the uterus, along with placenta. Among the four young ones, three were normal (length 25-27 cm and weight 150-200 gm), and one was abnormal, with two heads (bifurcated head) and a single body. The total length of the teratoid individual was 20.6 cm on the right side and 20.0 cm on the left side of the head regions and weight was 104.3 gm. Morphologically when the neural fold deviated during the early development it formed two heads with a single body (Fig. 1). The deformed individual had a separate placenta connected to the uterus. There was no morphometric and meristic difference between the normal and abnormal individual except the teratoid trait. The right and left head measurements were 5.5 cm and 4.8 cm respectively. It was observed that it possessed only one pair of pectoral fins (one behind each head), on the ventral side, and two dorsal fins (one behind each head) instead of a single dorsal fin. This abnormal individual showed an underdeveloped snout and mouthparts on one head (left head) while the other head, had its mouthparts normally developed. Since the specimen was rare it was not dissected for further study and was preserved in 4% formalin, and kept in our department museum.

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REFERENCES

Compagno, L.J.V. & V.H. Niem (1998): Carcharhinidae. Requiem Sharks. Pp. 1312-1360. *In*: Carpenter, K.E. and V.H. Niem (Eds:): FAO Identification Guide for Fishery purposes. The Living Marine Resources of the Western Central Pacific. FAO, Rome.

Compagno, L.J.V., W. White & S. Fowler (2003): *Carcharhinus hemiodon*. IUCN 2004. 2004 IUCN Red List of Threatened Species.

18. NOTES ON THE BEHAVIOUR OF SOME DUNG BEETLES IN AND AROUND BANGALORE[1]

K. Veenakumari[2] and G.K. Veeresh[3]

[1] Accepted May 04, 2005
[2]Project Directorate of Biological Control, P.B. No. 2491, H.A. Farm Hebbal, Bellary Road, Bengaluru 560 024, Karnataka, India.
Email: veenapmraj@rediffmail.com
[3]Unive 'sity of Agricultural Sciences, G.K.V.K. Bengaluru 560 065, Karnataka, India.

On the basis of dung utilization behaviour Heinrich and Bartholomew (1979) classify Coprophagous beetles into three groups: (i) those that feed and breed in dung pats (endocoprids) (ii) those that tunnel into soil, pack dung to subsequently feed and breed in it (paracoprids) and (iii) those that roll dung away from the dung pat which is further used for both feeding as well as breeding (telecoprids). Hitherto unknown details of dung utilization in two dung buriers, namely *Heliocopris bucephalus* (Fabricius) and *Onthophagus duporti* Boucomont, as well astwo dung rollers, namely *Scarabaeus* (*Khepher*) *sanctus* (Fabricius) and *Sisyphus hirtus* Weidemann, are detailed below.

Table 1: Duration and dimensions of the immature stages of *Onthophagus duporti*

Developmental time (days)	Egg		Larva		Pupa	Total	
All individuals	3.48±0.48 n=20		12.59±1.23 n=15		4.36±1.48 n=15	20.48±1.65 n=9	
Dimensions (mm)	Egg stage I	Egg stage II	I instar	III instar	Pupa	Cocoon	Brood ball
All individuals*	L-2.4±0.1 n=15 B-1.0±0 n=15	L-2.5±0 n=7 B-1.5±0 n=7	6.0±0.9 n=15	13.1±1.5 n=18	L-7.7±0.9 n=14 B-4.7±0.3 n=14	L-9.1±0.6 n=16 B-7.2±0.7 n=16	L-23.0±2.1 n=2 B-14.2±5.3 n=12

*L = Length, B = Breadth

Onthophagus duporti

Adults are found throughout the year. They are the most abundant Scarabaeinae in dung pats and are found in greater numbers along the margins of dung pats and in the rhizosphere. As many as 255 adults were found in a single cow dung pat in November.

This species nests at depths of 8-10 cm by fashioning several cylindrical brood masses in each of which a single egg is laid. The eggs are cream to yellow, cylindrical and fixed by the pointed end to the egg cell. The eggs increase in size and change to spheroids towards completion of the incubation period (Table 1). On hatching, the larvae not only resemble but also behave and nest in a manner identical to *O. gazella* and *O. rectecornutus* (Veenakumari and Veeresh 1996). As *Onthophagus* is a very large genus similar observations have been made on other species in the genus (Horgan 2001; Hunter *et al.* 1996; Lee and Peng 1982).

The durations taken for completing different developmental stages and measurements of these stages, including cocoon and brood mass, are presented in Table 1.

***Heliocopris bucephalus* (Fabricius)**

Both cow and elephant droppings attract adults of *H. bucephalus*. They make shallow food burrows and provision with less dung when compared to brood burrows which are much deeper and provisioned with larger quantities of dung (2,029 g). After excavating dung pats the beetles dig and excavate soil with their clypeus and forelegs to construct food and brood burrows. Males and females dig independent food burrows and provision them with food. Burrows from which food is exhausted are abandoned and fresh burrows constructed and provisioned with food. On the other hand brood burrows were constructed collectively by both males and females. A large amount of soil (1,014 g ± 36.32, n=3) was also excavated while constructing these brood burrows. Bisexual cooperation was exhibited by these beetles, similar to that in *H. dilloni* (Kingston and Coe 1977). The male was found in the upper part of the tunnel while the female was confined to the lower part of the tunnel. The tunnel was straight with no deviations for a distance of 20 cm after which it was oblique, ending in a chamber. The brood burrows were deeper than the food burrows. Kingston and Coe (1977) worked on the nesting behaviour of *H. dilloni* in Kenya and suggested that the brood chamber's depth varied to avoid both extreme climatic conditions as well as predators. Two to three adults of the kleptoparasite *Onthophagus turbagus* Walker were found in half a dozen brood balls. The different brood chamber parameters are mentioned in the Table 2.

When disturbed, the adults produced a loud, screeching noise by rubbing their hind coxae against their abdomens,

Table 2:Brood ball and burrow dimensions of some dung beetles

	Scarabaeus sanctus	*Sisyphus hirtus*	*Heliocopris bucephalus*
Diameter of dung ball (cm)	4.09±1.23 n=5	0.95±0.15 n=7	-
Weight of the food ball/mass (g)	45.23±22.94 n=5	0.136±0.006 n=7	186.5±18.45 n=3
Dry weight of soil excavated (g)	79.9 n=1	-	1014±36.32 n=3
Time taken to bury a dung ball (minutes)	25 n=1	-	-
Depth of brood cell (cm)	16±1 n=3	-	90
Weight of the brood ball/mass (g)	105 n=1	-	2029
Diameter of food burrow entrance (cm)	-	-	4.9±0.22 n=4
Depth of food burrow (cm)			28±12.88 n=5

which is probably an anti-predator mechanism (Arrow 1931; Narendran and Joseph 1978).

***Scarabaeus (Khepher) sanctus* (Fabricius)**

Adults of *S.* (*K.*) *sanctus* emerged from the soil in June-July with the first monsoon showers. Guided by olfaction they flew and dropped a short distance from either sheep or cow dung. Walking up to the dung with raised antennae each beetle cut out a circular mass of dung using its clypeus and forelegs, and fashioned a spheroid. Once fashioned, the ball was rolled away from the dung pat in the direction of the wind by pushing with the forelegs while the beetle walked behind the ball on its hind legs. In 1963, Matthews divided the whole process of ball making into different phases, namely 'cutting phase', 'shaping phase', 'rolling phase' and 'burying phase'. While rolling, the beetle paused repeatedly to shape the ball and to inspect the soil to find a suitable spot for burying it. Having dug deep the beetle emerged from the pit, pushed the ball in and disappeared beneath the ball to continue digging and slowly sank the ball into the soil. In one instance it took 25 minutes for a beetle to bury a brood ball and in the process 79.9 g of soil was excavated. The dimensions of brood balls are mentioned in Table 2. When these beetles were disturbed they produced a screeching noise.

The presence of small soil mounds indicated the presence of these beetles in the soil. On removing such mounds a hole marking the entrance to a tunnel was seen. Tracing this revealed mating pairs of beetles along with dung masses. In some instances, additional males were present nearby indicating male competition for a mate. Males were also noticed to fight each other for possession of dung balls right from ball making to rolling, which continued even after burying. This resulted in dung balls being abandoned near dung pats. Legs, elytra and other body parts lost in such battles were found in the vicinity of these dung balls, which once abandoned were utilized by dipterans and by *Onthophagus ramosus* (Weidemann). Similar combats have been reported for *Scarabaeus*, *Gymnopleurus* and *Sisyphus* (Halffter and Matthews 1966). In 50 per cent of the instances observed individuals of *Onthophagus* sp. were found in the dung balls fashioned for food by *S. sanclus*, indicating intraspecific competition for food.

Bisexual cooperation was observed in this species of *Scarabaeus* also. Sato (1998) reported that the males of *S. catenatus* not only help the female in rolling dung balls but also take an active part in nesting thus proving bisexual cooperation. He labels this as 'mate guarding' to ward off intrusion by conspecific males.

***Sisyphus hirtus* Weidemann**

These beetles too emerged in July with the first monsoon showers and were attracted to both sheep and cow dung. The detached mass of dung was fashioned into a spheroid by compaction against the body. The dimensions of the dung ball are mentioned in Table 2.

Balls were rolled by beetles either singly or in pairs. When a single beetle rolled a ball, it pushed the ball with its hind legs while it stood on its fore legs in a head-stand position. When rolling in pairs the female pushed with its hind legs from behind while the male stood on its hind legs in front of the ball and pulled with its forelegs. The balls were rolled on varied terrain and over numerous obstacles. A pair of beetles was noticed attempting to roll a ball up a 700 slope. The beetles tumbled down the slope many times along with the ball before they finally abandoned it and flew away. Rolling over obstacles has been observed in various species (Fabre 1897; Hingston 1923; Halffter and Matthews 1966). Similarly, as observed by Puzanova-Malysheva (1956) in *Scarabaeus sacer*, *S. hirtus* too, at times, abandoned a ball that it was rolling, flew back to the dung pat, fashioned a larger ball and began rolling it in the same direction as the ball it had abandoned.

After inspecting and rejecting a number of places, a place would finally be selected and the ball buried. While the female sat on the ball, guarding it the male dug a pit with its fore tibiae and clypeus. The male then pushed the ball in, went below the ball and continued digging till it completely disappeared in the soil. The female then entered the soil and mated.

The main purpose of rolling the dung ball away from the pat might be to attract the opposite sex for mating and to ensure adequate provisioning of food for the couple during coitus. Rolling the ball away from the dung pat and burying it in the soil might reduce desiccation, and thus help in maintaining the proper consistency of dung. Heymons and Lengerken (1929) infer that rolling reduces moisture content and achieves proper consistency as preferred by *Scarabaeus*. It also reduces competition with dung buriers at the food source (Halffter and Matthews 1966).

REFERENCES

Arrow, G.J. (1931): The Fauna of British India including Ceylon and Burma, Coleoptera: Lamellicornia. III (Coprinae). Taylor and Francis, London, 428 pp.

Fabre, J.H. (1897): Souvenirs Entomologiques Vol. V. Paris. Translation by de Mattos, A.T. Lonson, 296. pp

Halffter, G. & E.G. Matthews (1966): The natural history of dung beetles of the subfamily Scarabaeinae. *Folia ent. Mex. 12-14*: 1-312.

HEINRICH, B. & G.A. BARTHOLOMEW (1979): The ecology of the African dung beetles. *Scient. Amer. 241*: 118-127.

*HEYMONS, R. & H. LENGERKEN (1929): Biologishe Untersuchungen on coprophagen Lamellicomein. I. Nahrungaerwerb and Fortpflanzungsbiologie der Gattung *Scarabaeus* Linnaeus. *A. Morh. Okol. Tiere. 14*: 531-613.

HINGSTON, R.W.G. (1923): A Naturalist in Hindustan. H.F. and G. Witherby, London, 292 pp.

HORGAN, F.G. (2001): Burial of bovine dung by coprophagous beetles (Coleoptera: Scarabaeidae) from horse and cow grazing sites in El Salvador. *European J. Soil Biol. 37(2)*: 103-111.

HUNTER, J.S., G.T. FINCHER & D.C. SHEPPARD (1996): Observations on the life history of *Onthophagus depressus* (Coleoptera: Scarabaeidae). *J. Entmol. Sci. 31(1)*: 63-71.

KINGSTON, T.J. & M. COE (1977): The biology of a giant dung-beetle (*Heliocopris dilloni*) (Coleoptera: Scarabaeidae). *J. Zool 181(2)*: 243-263.

LEE, J.M. & Y.S. PENG (1982): Influence of manure availability and nesting density on the progeny size of *Onthophagus gazella. Envir. Ent. 11(1)*: 38-41.

NARENDRAN, T.C. & K.J. JOSEPH (1978): Mechanisms of sound production in *Reliocopris bucephalus* (Coleoptera: Scarabaeinae). *Entomon. 3*: 297-299.

PUZANOVA-MALYSHEVA, E.V. (1956): Povedenie zhuka Skarabeya - *Scarabaeus sacer* L. (Coleoptera; Scarabaeidae). *Trudy Yses. Ent. Obehch. 45*: 51-71.

SATO, H. (1998): Male participation in nest building in the dung beetle *Scarabaeus catenatus* (Coleoptera: Scarabaeidae): mating effort versus paternal effort. *J. Insect Behav. 11(6)*: 833-843.

VEENAKUMARI, K. & G.K. VEERESH (1996): Some aspects of the reproductive biology of *Onthophagus gazella* (F.) and *Onthophagus rectecornutus* Lansb. (Coleoptera: Scarabaeidae). *J. Bombay Nat. Hist. Soc. 93(2)*: 222-256.

* original not seen

19. PROTEIN PROFILE OF HAEMOLYMPH FROM *APIS* SPECIES[1]

NEELIMA R. KUMAR[2,3] AND LALITA NEGI[2,4]

[1]Accepted June 07, 2004

[2]Department of Zoology, Punjab University, Chandigarh 160 014, India.
[3]Email: neelimark@yahoo.co.in
[4]Email: nlalita@ymail.com

Molecular or biochemical considerations are comparatively new tools in honeybee systematics. Though these have been extensively used in the case of *Apis mellifera* (Mestriner 1969; Mestriner and Contel 1972; Sylvester 1986; Lee *et al.* 1989; Sheppard and Berlocher 1989), not much is known about the molecular and biochemical systematic aspects of the Asian honeybee species. It is necessary to integrate morphometric, biological and behavioural data with molecular studies for valid identification of races or geographic ecotypes in case of honeybees. Keeping this in view, studies on biochemical characterizations of honeybee species and populations were carried out.

High hills worker bees of *Apis cerana* were collected from Kinnaur, Himachal Pradesh (2,500 m above msl), and of the plains from the botanical garden, Punjab University, Chandigarh (320 m above msl). *Apis mellifera* workers were taken from the maintained apiary and *Apis dorsata* from natural nesting sites from the Punjab University campus. The haemolymph of worker honeybees was sucked with an auto pipette, by pinching off between two adjacent tergites of the abdomen of the bee. It was then diluted with sample buffer in the ratio of 1:1. For protein profiling, standard technique of SDS-PAGE (Laemmli 1970) was employed.

During the present studies, nine protein fractions were

Table 1: Protein fractions in haemolymph of *Apis* species

	Standard		*A. cerana* of high hills		*A. cerana* of plains		*A. mellifera*		*A. dorsata*	
Sr. No.	Mol. Wt. (kD)	Rf. Values	Mol. Wt. (kD)	Rf. Values	Mol. Wt. (kD)	Rf. Values	Mol. Wt. (kD)	Rf. Values	Mol. Wt. (kD)	Rf. Values
1.	480	0.2765	480	0.2765	4400	0.04255	210	0.36	250	0.34
2.	67	0.48	300	0.3101	3000	0.085	41.9	0.53	67	0.48
3.	45	0.51	96	0.4468	2000	0.1276	45	0.51	45	0.51
4.	24	0.5951	67	0.48	1650	0.1489	24	0.5951	24	0.5951
5.	18	0.6170	45	0.51	1050	0.17	-	-	-	-
6.	-	-	29	0.57	400	0.29	-	-	-	-
7.	-	-	-	-	67	0.48	-	-	-	-
8.	-	-	-	-	45	0.51	-	-	-	-
9.	-	-	-	-	41.9	0.53	-	-	-	-